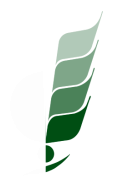


Final Report  
January-November 2013

**Intensification of maize-legume based systems** in the semi-arid areas of Tanzania (Kongwa and Kiteto districts) to increase farm productivity and improve farming natural resource base

Submitted to

**IITA**



This work was

undertaken as

part of the



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***Africa RISING Progress Report Template***

***Instruction:*** *This template should be used for interim and final technical reports. Final reports should include supporting data (tables and graphs) under Section D. No tables and graphs are needed for interim reports.*

**Reporting Period: (**Year 1 Final Report and September -November)

**Section A. Partner Information**

**A.1. Institute:** International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

**A.2. Contact person:** Dr Joanna Kane-Potaka, Director, Strategic Marketing and Communication, ICRISAT

## A.3. Intervention site, country: Tanzania (Kiteto and Kongwa Districts, Manyara Region)

## A.4. Partners

**Implementing partners**

1. Agricultural Research Institute - Hombolo
2. World Agroforestry Centre (ICRAF)
3. International Maize and Wheat Improvement Centre (CIMMYT)

**Associate Partners**

1. Tuboreshe Chakula
2. NAFAKA - Staple Value Chains
3. Agricultural Research Institute - Hombolo
4. University of Dodoma
5. Pasture Research Institute - Dodoma
6. District Agricultural Offices of Kiteto and Kongwa
7. Community leaders in target villages of Kiteto and Kongwa

**Section B. Summary of progress/achievements during the reporting period** (What are the two key achievements?)



This work is being undertaken

as part of the



This work is being undertaken

as part of the

1. **New highly resilient and productive genotypes identified**: Experimentation to identify well-adapted genotypes for these dry lands has led to identification legume material that yields six fold over and above performance of local material. Pigeon pea varieties that yield up to 1.8 tons/ha have been identified, whilst groundnut varieties yielding up to 1.5 t/ha under these dry conditions have been identified. These varieties will underpin our legume-cereal agro-ecological intensification efforts in Kongwa and Kiteto.
2. **Benchmarks for integrated crop – livestock productivity enhancement**: During this year we have been able to characterize these agro- silvo-pastoral communities. Pigeonpea and groundnuts fits well into their farming systems providing food and feeds for humans and livestock respectively. We have identified higher yielders of food and crop residues that can be integrated into local livestock production systems also called *Alalili* by the Masaai the local community in these districts. The legumes will also be used in integrated soils fertility management and at the same time contribute to food and income security of communities. In the coming year (2014), we will evaluate the drought hardy cereals (sorghum and pearl millet) and legume (bambara nuts) which our benchmark studies show are the bulwarks for food security in central Tanzania.

**Section C. Implemented work and achievements per output**

**C.1 Research Output 1 (RO1): Situation analysis and program-wide synthesis.** (***This is not an implementation focus of our project***)

**C.2 Research Output 2 (RO2): Integrated Systems Improvement.** Please refer to the Program Document for Activity Headings.

**C.2.1. Activity:**

**C.2.1.1 Implemented work:**

This report comprises activities undertaken under the following work packages:

1. Work package 1. On-farm evaluation of improved legume and cereals varieties;
2. Work package 2. Integrated soil fertility management in action areas;
3. Work package 3. Land management (soil and water conservation) in action areas;
4. Work package 4. Post-harvest processing, utilization and nutrition;
5. Work package 5. Crop, livestock, and poultry integration and productivity enhancement;
6. Work package 7. Lesson learning, networking and coordination.



This work was undertaken as

part of the

**C.2.1.2 Achievements (progress and/or results): Summary of progress against outputs**

| **Work package** | **Planned activities** | **Outputs** | **Progress against outputs during this quota** |
| --- | --- | --- | --- |
| **WP 1**. On-farm evaluation of improved legume and cereals varieties. | 1. Community mobilization 2. Evaluate performance of stress tolerant maize varieties under farmer field conditions. 3. Quality Protein Maize (QPM) variety demonstration. 4. Evaluate performance of improved pigeonpea varieties under farmer field conditions. 5. Evaluate performance of improved pigeonpea varieties under farmer field conditions. 6. Pilot community seed production for groundnut and pigeonpea. | 1. At least two adapted varieties of maize identified for target areas | 1. **QPM**: Due to late arrival of seed compounded by quarantine issues this experiment is will now be implemented this coming season. |
| 1. At least two adapted varieties of pigeonpea identified for target areas. | **Pigeonpea**: On farm yields of seven genotypes were evaluated with the following outcomes: (ICEAP 00554- 1412.5 t/ha), ICEAP 00557-1779.2 t/ha, ICEAP 936-833.3 t/ha, ICEAP 932-1795 t/ha**,** ICEAP 933-1779.2 t/ha) compared to the released variety ICEAP 00040 (Mali) which had 17795.8 t/ha. All elite material performed between 4 to six fold above the local land race that had 125 kg/ha. Thus the new material provides new sources for genetic intensification drives. They will be re-evaluated in 2013-2014 for release and promotion activities |
| 1. At least two adapted varieties of groundnut identified for target areas. | **Variety selections.** Five improved varieties: Mnanje 09 (ICGV-SM 83708), Nachingwea 09 (ICGV-SM 01711), ICGV-SM 02724, Mangaka, Pendo (ICG SM 33) and one land race were evaluated at Kongwa-Moleti, Chitego, Laikala and Mlali and Kiteto- Njoro to identify best adapted cultivars for these dry areas. The best genotype was ICGV-SM 02724 with a yield of 1.5 t tons /ha compared to Pendo (0.6 t/ha) a popular variety. The released genotype Mnange had 873 kg/ha and was the second best adapted. The land race gave 273.3 kg/ ha about 3 times less than second best material. Further evaluations for integration will be performed in 2013-2014. |
| 1. Strategies for community-based seed production piloted and validated for up-scaling. | **Seed systems** Community seed production of pigeonpea (Mali) & groundnut (Pendo-ICGMS 33) initiated at Kongwa-Moleti, Chitego, Laikala and Mlali and Kiteto- Njoro. Total seed harvested is 3.5 tons that will be injected into the community this coming season. |
| **WP 2**. Integrated soil fertility management in action areas | 1. Community mobilization Development of appropriate fertilizer application rates. 2. Combined use of organic and inorganic nutrient sources for fertility and soil moisture. 3. Promoting soil fertility management using. inorganic fertilizers 4. Evaluation of intercropping technologies as part of ISFM. 5. Cost-benefit analyses. | 1. Major limiting soil nutrients for crop production identified to guide fertilizer application. | 1. **Limiting nutrients and application rates.** Preliminary results show that the optimum P rate for maize production is ***30 kg P ha-1*** and is associated with the maximum yield. For sustainable use farmers, may however, apply ***15 kg P ha-1*** without losing maize yield significantly 2. Maize response to N fertilizer was poor, suggesting that response to N application in maize were possibly constrained by other factors, including very low soil P and limited moisture. Further confirmation will be done this year (2013-2014). |
| 1. Improved in-organic fertilizer usage by farmers in NAFAKA operational areas. | **Intercropping trials.** In year 1 limited experimentation on use of organic manures. Farmyard manure (FYM) the most common source of organic fertilizers were used. Preliminary results show that FYM fertilized had healthier plants resulting with visually more podding than the non fertilized plots. Analysis of the benefits is on going. Experiments will be done on the interactive effects of organic and inorganic fertilizers. In organic fertilizers were not used in this experiments in year 1. |
| 1. Strategies for use of intercropping to improve soil fertility and yield developed | **Intercropping trials.** Groundnuts, pigeonpea, under maize intercropping trials were experimented on in Kiteto (Njoro) and Kongwa in all villages (Moleti, Chitego, Laikala and Mlali). Analysis of benefits are on-going due to late harvesting of the crop. |
| 1. Cost-benefit analyses for various soil nutrient replenishment options determined. | **Cost-benefit analysis**. Design of the cost benefit analyses studies have been completed and will be reported in next period |
| **WP 3**. Land management (soil and water conservation) in action area | 1. Community mobilization. 2. Soil erosion management technologies. 3. Soil water management technologies. 4. Cost benefit analysis. | 1. Best bet soil water conservation technologies validated. | **Technologies validated.** During this reporting period we have held planning meetings with farmers in Kongwa and Kiteto. Due to landscape nature of planning required meetings with district officials will be held on 29th October to mobilize the community and administration for 2014 activities. |
| 1. Strategies to improve soils and water management developed | **Soils water management.** *In situ* water management strategies examined such as, ripper, tillage and tie ridging were compered with conventional tillage ox drown (Kongwa) and tractor driven (Kiteto). These districts vary in their farm operations. At Kiteto, maize grain yields produced were 1.6 tons/ha for conventional tillage and 2.7 tons/ha for ripping tillage. Conversely, at Kongwa, maize yields varied from 2.1 to 3 tons were obtained. These *institu* water harvesting equipment Ox-ripper and ox-ridger tillage increased yield by 25% % and 30 % respectively. These results will be verified further in 2014 for scaling up purposes. |
| 1. Cost-benefit analyses for soils and water management done | **Cost-benefit analyses**. Cost benefit analysis was not conducted however the analytical framework was completed. This will be done in 2013-2014. |
| **WP 4**. Post-harvest processing, utilization and nutrition | 1. Competitiveness of pigeonpea as alternative protein crop studied 2. Aflatoxin in maize, groundnut, pigeonpea, bean, bambara nuts & sorghum 3. Awareness raising among partners on aflatoxin 4. Profile value chain for contamination points | 1. Various products for use of pigeonpea evaluated and scaling up opportunities investigated. 2. Farmers sensitized on aflatoxin dangers. 3. Contamination points for aflatoxin along value chains investigated to target mitigation. | Baselines for action established from garden-to-fork for legumes and cereals in Kongwa and Kiteto. In August 2013. Highlights of the results were:   1. Productivity is very low for legumes (groundnuts, bambara nuts) and cereals (sorghum pearl millet and maize) with farmers getting less than 50% of potential yield. 2. Very high levels of aflatoxin was found in 70% of samples which had up to 4000 ppb) in groundnut. Bambara nuts had (43.5 % 1ppb to 411ppb). 3. Knowledge of aflatoxin was minimal (19%). 4. All market samples had higher than the 20ppb threshold for aflatoxin in food products 5. These results shall be used to design interventions in the 2013-2014 period. |
| **WP 5**. Crop livestock and poultry integration and productivity enhancement | 1. Community mobilization for action. 2. Integrated crop tree/livestock productivity. enhancement 3. Poultry feeds/production. | 1. Nutritional quality of indigenous forage and pasture species determined for fodder and pasture. 2. Identification of appropriate fodder trees and shrubs for integration in maize-based farming systems | Evaluations of predominant fodder sources in Kongwa and Kiteto (*Acacia senegal, A. torilis, A. xanthophloea, A. mellifera, Boscia mosambinscensis, Leucaena leucocephala,* and *Mellia azedrach* revealed that:   1. *L. leucocephala* and *M. azedrach* had the highest Crude proteins (231 and 249 gkg-1 dry matter) well above maize stover (58 gkg-1) used in periods of dray weather and within the minimum threshold of 80 gkg-1 dry matter. These forage species can thus be used as protein supplements for the low qualify feeds resources such as *Aristida* spp. commonly used in the region. 2. Characterizationof the agro-silvo-pastoral systems revealed contrasting management systems. At the on the onset of dry season, livestock in both districts are first grazed on crop residues (maize, sorghum, sunflower & groundnut straws. In Kiteto after the crop residues are exhausted, the livestock are normally grazed on preserved pastures whilst in Kongwa livestock are solely dependent on crop residues. This strong interaction will be explored in 2013-14 for integration of intensification drives. 3. Dominant herbage species were *Cynodon dactylon* (15.9 %), *Cynodon* spp. (11.2 %), *Cenchrus ciliaris* (12.9 %), *Dicanthium* spp. (17.8 %), *Eragrostis* spp. (9.2 %), and *Panicum* spp. (11.7 %). Grass species constituted (75.8-92 %) compared to forage species (20.3-42.6 %). Rangelands in Kiteto district had higher basal cover of 67.8 to 88.3 % mean = 65.2%) than those of Kongwa district (45-80 %; mean = 59.8 %). These species will be evaluated for integration into farming systems of these regions. |
| 1. Propagation of best-bet forage and pasture species for planting on-farm in 2014 growing seasons |
| **WP 6.** Characterization of Africa RISING sites project site | Conducting biophysical baselines at landscape and farm levels to provide data for assessment of tested technologies in targeted areas. | 1. Baseline report highlighting soil conditions and major constraints to SI in targeted areas 2. Initial site condition of field sites targeted for on-farm trials evaluated and documented for M&E and impacts assessment. | 1. A sentinel block of 10 km2 has been established in Kongwa for landscape assessment of soil and vegetation using the land degradation surveillance framework. 2. Infiltration measurement is being done in one of the plots. 3. Soil sampling and analysis are on-going. |
| **WP 7**. Lesson learning, networking and coordination | 1. Develop communication strategy 2. Networking and coordination. 3. Assessment of technologies and lessons learnt | 1. Effective communication tools developed and used. 2. Benefits of technologies and suitability for intensification validated. 3. Lessons for scaling up and out of the project captured and documented. | Project report back meeting with both district communities were held in October from 20-26th. A follow up meeting with district officials will be held in Dodoma to plan for 2013-2014 season.   * 1. **Partnerships:** Due to the diverse nature of the landscape we are working in partners keep changing. For the period we have been on the ground Pre-season engagement is critical for buy-in it can however be costly.   2. **Benchmarks are critical:** R4D targeting within investment domains are easily compounded by fluidity/complexity of subsistent agriculture especially resource endowments. Only (**12% can access credit**). This may affect scaling up and out.   3. **Champions for change**: Only **9% of farmers are member of farmer organisations.** Thusalternative models for diffusion may be needed. Champions at community level are essential using existing socio-political structures may help knowledge diffusion. |

**C.3 Research Output 3 (RO3): Scaling and Delivery**

The focal activity within RO3 is to pilot test scaling approaches from action sites within the project area. This project area receives only one season of rainfall. Thus many of the scaling up actions will only be implemented starting in November 2013 when the rains are expected.

**C.3.1. Focal activities for 2012-2013 and 2013-2014:**

1. **Community seed systems**. We will continue with implementation of community seed production systems for legume seeds that generally are not part of the formal seed sector are being piloted. We are working with farmer groups in Kongwa and Kiteto districts. Season one raised about 3 tons of seed. We will use this as part of the seed pass on programme. Pendo the variety produced while popular elsewhere was not selected by farmers in the dryer areas. We will thus produce Mnange and ICGV-SM 02724 the best performers in these dry ecologies.
2. **Field days and demonstrations**. Farmer field days and participatory variety selection for legumes have been initiated in both Kongwa and Kiteto districts. We will use the mother baby trials approach for action research as well as promotional activities.

**C.4 Research Output 4 (RO4): Monitoring and Evaluation.** Please refer to the Program Document for Activity Headings.

**C.4.1. Activity:**

The focal activity within RO3 is to undertake participatory impact pathway analysis and identification of indicators.

**C.4.1.1 Implemented work:**

A national stakeholder consultative meeting to map out a critical path for the success of the project was held in in April 2013. A follow up workshop involving scientists and district officials and target communities is planned for 29th October. Key results from each work package are being presented. During the workshop will well examine improve integration to deliver the agreed-upon results within the context of agro-ecological intensification. The will drew researchers from Tanzania NARS (ARI-Hombolo, Naliendele) and Pasture Research Institute, IITA, ICRAF, ICRISAT and frontline development projects funded by USAID-Feed the Future, such as NAFAKA and Tuboreshe Chakula as well as the District Agricultural Extension leaders of Kiteto and Kongwa.

## C.5. Research Deliverables

**C.5.1. Products**

|  |  |  |
| --- | --- | --- |
| **Improved maize (cereals)** | **Improved Pigeonpea (legume)** | **Improved groundnut (legume)** |
| 1. QP Maize Lishe K1, | **Released Variety**: Mali-(ICEAP 00040), | **Released Varieties:** Mnanje 09 (ICGV-SM 83708), Nachingwea 09 (ICGV-SM 01711), and Pendo (ICGMS 33), ICGV-SM 02724 and Mangaka |
| 1. New varieties: Lishe H1 and TANH611 | **Non-released**: materials: ICEAP 00554, ICEAP 00557, ICEAP 936, ICEAP 932**,** ICEAP 933. |  |

**C.5.2 Technology/technologies transferred**

We are using an action research model through which farmers can start to pick up technologies they find most suited to their needs. Examples of technologies being evaluated with potential for uptake are presented below.

|  |  |  |
| --- | --- | --- |
| **Technology** | **Target within intensification** | **Status to date** |
| 1. In situ water harvesting | Improve soil moisture intake | On-going- promising results with 20-30% yield advantage |
| 1. Intercropping (legumes and cereals | Increase land productivity and fertility management | On-going- Pigeonpea and groundnut lines are being evaluated together with dry land cereals maize, (sorghum and pearl millet- which are new crops following needs assessment of the cropping patterns in the study sites. |
| 1. Contour bands | Soil Erosion control | Communities have been mobilized to engage in this action in the 2013-2014 season. An action research model is being used |
| 1. Agroforestry-silvo pastoral technologies | Fodder and supplementary feeds for livestock | Communities have been mobilized to engage in this action in the 2013-2014 season. An action research model is being used |
| 1. Integrated soil fertility management | Improve soil fertility | On-going- promising results our findings show that one can use lower rates than the blanket recommended rates |

**C.5.3 Meetings/presentations**

|  |  |  |
| --- | --- | --- |
| **Meeting** | **Period** | **Presentations made** |
| USAID Innovation Labs | March 2013 | ICRISAT interventions into dryland agro-ecologies of Tanzania |
| Project Inception meeting | April 2013 | Overview of project to diverse stakeholders |
| Project review meeting Africa Rising | September 2013 | Overall progress review meeting held in Lilongwe, Malawi |
| African Crop Science Conference | October 2013 | Posters and papers on Agro-ecological intensification efforts |

**C.5.4 Reports/publications**

No major publication so far from the work since the project has just been initiated less than six months ago. Four abstracts for the World Agroforestry Congress in India in February 2014 and 1 for the African Crop Science Congress have been produced.

## C.5.5. Capacity building (Type of training, number and category of people trained)

|  |  |  |  |
| --- | --- | --- | --- |
| **Category of trainees** | **Number trained** | **Skills sets** | **Affiliation** |
| Scientists+ technician | **5** | Participatory plant breeding | ARI- Hombolo |
| Farmers | **7** farmer leaders and **560** farmers in total | * Agronomy of groundnut and pigeonpea production * Seed production | Kiteto and Kongwa select sites |

## C.6. Problems/challenges and measures taken (100 words)

* **1a. Problem**: The initial start of the project was slow and rather late and may have missed out random selection of farmers for engagement. **1b. Measures taken:** We have engaged farmers, district agricultural officers and community leaders to identify farmers and action areas for the 2013-2014 season.
* **2a. Problem**: Not all project components have taken off especially the cots benefit analysis. **1b. Measures taken**: Staffing and design complications have been addressed and the work is now planned for 2013-2014 season.
* **3a. Problem**: **New material evaluation**: We were not able to grow all the new maize genotypes we had planned to introduce due to late arrival of material. **2b**. **Measures taken:** The materials have been assembled. These materials were slated for participatory variety selection and will be planted in the 2013-2014 season.
* **4a Problem**: Experimental design issues. Work package 4 on food (aflatoxin) and processing required revisiting our research approach especially after conducting a baseline. This has meant some of the originally planned work was dropped. **3b**. **Measures taken:** We have used the base line study to plan 2013-2014 and subsequent work. This approach has also allowed us in-build other partner act.

## C.7. Partnership/linkages with other projects (100 words)

The rational for engagement is indicated in parenthesis in bold.

* **1. Engagement of strategic partners**.We have engaged Tuboreshe Chakula (***for nutrition and value added products***), NAFAKA (***for*** ***production and scaling up and out***) and the district agricultural staff (government support and extension support).
* **2. Linkages with other projects**. We have engaged with the IITA Aflatoxin team working in Babati to share research tools and methodologies in April this year. We have also engaged Sokoine University (**Aflatoxin work**) and University of Dodoma and Pasture Research Institute (**feeds and feeding**). These are now part of the project implementation team.

## C.8. Lessons learned (100 words)

1. **Project design**: Intensification process requires R&D investment typologies to be completed, prior to implementation. Our intensification model (Year 1- experimentation, 2- piloting, 3- scaling up and out) was affected. While building this critical stage better location sites could have been selected.
2. **Implementation**: Intensification involves complex institutional and operational relationships. Understanding of what works and does not is critical for scaling up and design of appropriate interventions.
3. **Resource availability and partnerships.** In-time resource availability andmanagement of alliances calls for well-negotiated arrangements. Early negotiation on letters of agreement for these alliances is a fundamental lesson we have learnt.
4. **Benchmarks are critical**. Targeting within investment domains can be compounded by resource endowments (**12%farmers in this study area can access credit**). We have uses this benchmark to redesign implementation of some work packages.

**Section D. Tables and graphs in support of achievements, results**

**Research output: Situation Analysis and Programme-wide Synthesis 1**

**1. Production:** Crop yields in the study areas are in most cases less than 50% of the potential yield (Table 1).

Table 1. Baseline of production capacity of targeted research areas

|  |  |  |  |
| --- | --- | --- | --- |
|  | ***Average crop productivity (kg/ha) by crop and district*** | | |
| **Crop** | **Kongwa** | **Kiteto** | **Total** |
| Maize | 782.3 | 623.4 | 753.3 |
| Sunflower | 391.3 | 555.2 | 433.4 |
| Groundnut | 608.9 | 450.8 | 529.9 |
| Pigeonpea | 200.3 | 117.3 | 158.8 |
| Sorghum | 323.5 | 207.2 | 314.6 |
| Bambara | 332.7 | 160.6 | 295.1 |

**Source: Survey data form project team in Kongwa and Kiteto August 2013.**

**2. Food security.** Limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways remain key issues that intensification drive should address. Survey results show that the months of Jan (**21**%), Feb (**22**%) & March (**17**%) are the most lean months. Cash purchases (**62**%), labour exchange for food (**28**%) are major coping strategies for food insecurity.

Table 2. Food security related data.

|  |  |  |
| --- | --- | --- |
| ***Village*** | ***% House holds with enough food to last 12 months*** | |
| Yes | No |
| Moleti | 29.6 | 70.4 |
| Mlali | 46.8 | 53.2 |
| Laikala | 45.8 | 54.2 |
| Chitego | 54.7 | 45.3 |
| Njoro | 50.8 | 53.9 |

**3. Food safety and knowledge access.** 19% of households are aware of aflatoxin with 28% in groundnut & 26% in maize. Most farmers use grade-out grain for consumption yet these could be sources for contamination. Only 15% of the farmers throw away grade-outs whilst 45% eat them following roasting or as groundnut flour. In the case of maize 30% of the respondents mill the grade-outs in flour for human consumption. 40% of farmers in Kiteto received extension services on general crop production with only 4% on groundnuts. Under 10% of farmers belong to nay farmer organisation indicative of the social organisation.

**Research output 2: Integrated systems improvement**

**Work Package 1. Performance of Groundnut genotypes under participatory variety selection**

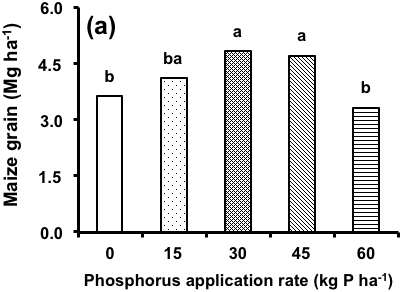
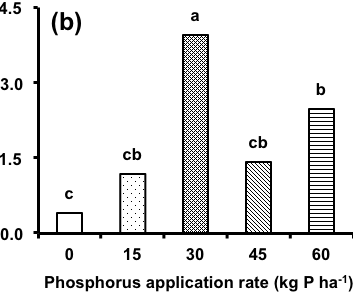
Table 3. Performance of groundnut varieties under PVS in Kiteto and Kongwa

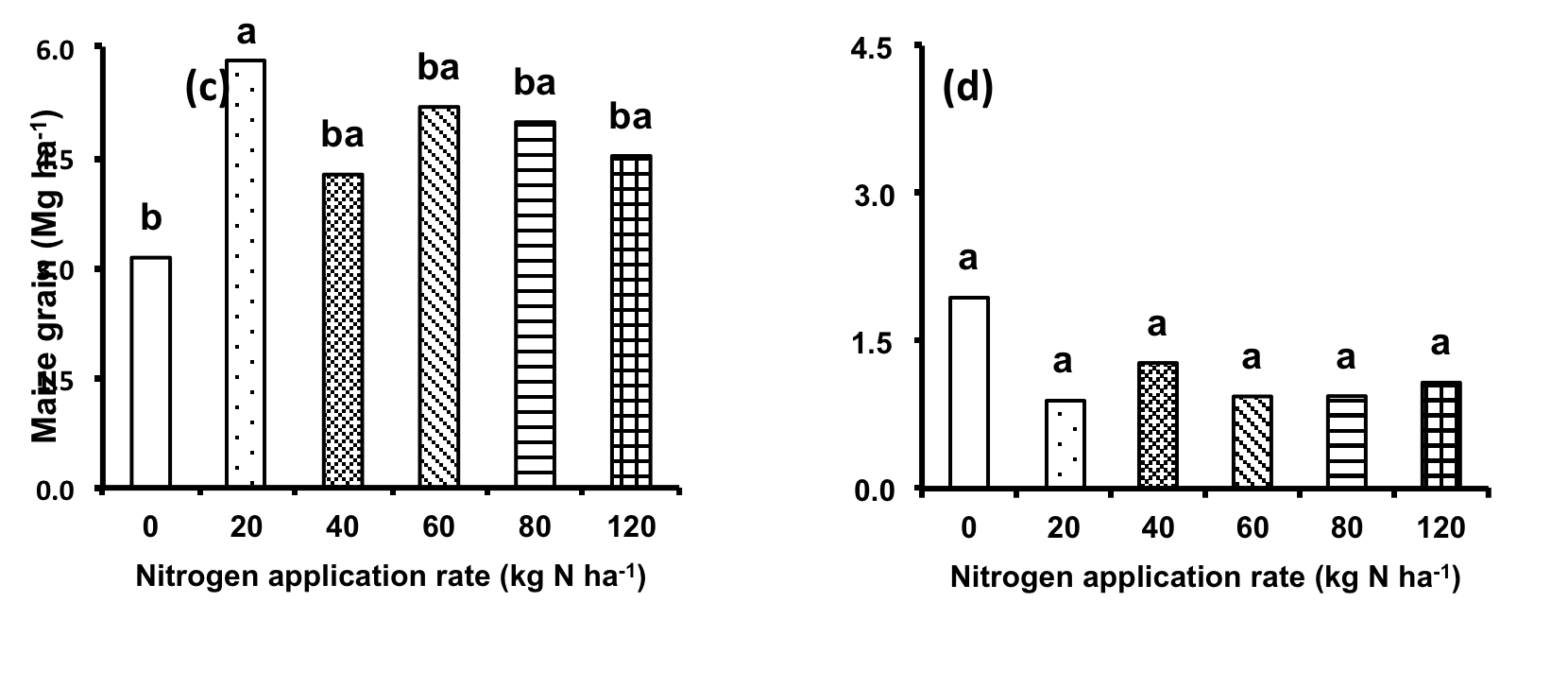
|  |  |  |
| --- | --- | --- |
| ***Varieties*** | ***Yield (tons/ha)*** | |
| Kongwa | Kiteto |
| 1. ICGV-SM 99568 | 0.55 | 0.44 |
| **2. ICGV-SM 02724** | **1.50** | **1.28** |
| 3. MANGAKA | 0.73 | 0.35 |
| 4. PENDO | 0.61 | 0.28 |
| **5.MNANJE** | **0.87** | **0.77** |
| **6. LOCAL LANDRACES** | 0.27 | 0.17 |

Bold faced genotypes were selected by farmers for up-scaling purposes.

**Work Package 2. Integrated soils fertility management**

The highlights presented indicated in Figure 1: Optimum P rate for maize is 30 kg P ha-1 (Fig. a, b). Farmers may apply 15 kg P ha-1 without losing maize yield. Maize response to N fertilizer was poor, suggesting other compounding factors, (Fig. c, d).





**Njoro Kongwa Mlali- Kiteteo**

Figure 1. Response to inorganic P fertilizers by maize crop

**Work Package 3. Land management (soil and water conservation)**

*Insitu* water harvesting technologies tested and showed yield advantage. Deep tillage improved yields of maize the test crop that is very sensitive to soil moisture. Deep tillage using the Ox-ripper and ox-ridger tillage increased yield by 25% % and 30 % respectively. Higher yields were obtained with tractor drawn implements (mainly in Kiteto which has extensive agriculture).

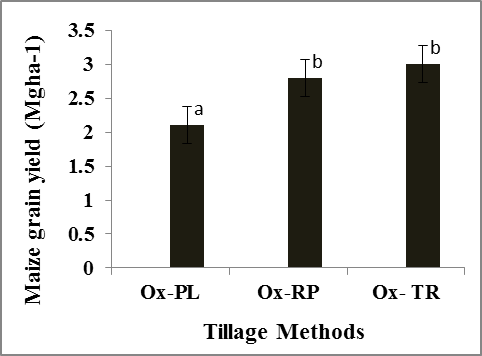
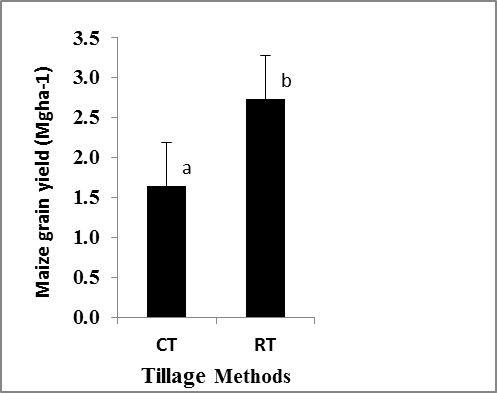
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Figure 2. Performance of maize crop under *insitu* water harvesting technologies. Source: Project activities in Kongwa and Kiteto 2013.

**Work Package 4. Processing, utilization and nutrition**

Most of the crops analyzed for aflatoxin contamination had over > 4 ppb and> 20 ppb the threshold for EU and USA the largest markets for various food products (Table 4). No aflatoxins were detected on beans pearl millet and pigeon peas. Source: Project activities in Kongwa and Kiteto 2013.

Table 4. Aflatoxin contamination in various grain crops sourced form households and markets in central Tanzania (Kiteto and Kongwa districts.

|  |  |  |
| --- | --- | --- |
| ***Crop*** | ***Number of samples*** | ***Aflatoxin (ppb)- incidence & levels*** |
| Groundnut | 163 | 70% had up to 4000 ppb |
| Maize | 366 | 20% had up to 340 ppb |
| Bambara | 78 | 43.5 % had up to 1ppb to 411ppb |
| Pigeonpea | 29 | 0 % |
| Beans | 4 | 0 % |
| P. Millet | 35 | 0 % |
| Sorghum | 64 | 11% (>10 ppb) |
| Sunflower | 143 | 13% had up to 293 ppb |
| Groundnut from markets | **28** | 100% had up to 504 ppb |
| Maize from markets | **23** | 26 % (>10ppb) |

**Work Package 5. Processing, utilization & nutrition**

**1. Species composition and biomass productivity of agro-silvopastoral fodder banks.** We conducted this study in semi-arid areas of Kiteto and Kongwa districts of Central Tanzania. Dominant herbage species were *Cynodon dactylon* (15.9 %), *Cynodon* spp. (11.2 %), *Cenchrus ciliaris* (12.9 %), *Dicanthium* spp. (17.8 %), *Eragrostis* spp. (9.2 %), and *Panicum* spp. (11.7 %). Grass species constituted the majority (75.8-92 %) compared to forb species (20.3-42.6 %). Rangelands in Kiteto district had higher basal cover of 67.8 to 88.3 % (mean = 65.2%) than those of Kogwa district (45-80 %; mean = 59.8 %). There was notable high variability (P<0.05) in biomass productivity both between rangelands. The rangelands had low biomass productivity ranging between 1.43 to 2.17 t DM/ha (mean 1.83 t DM/ha) in Kiteto district and between 1.74 to 2.65 t DM/ha in Kongwa rangelands. The rangelands had low carrying capacity (cannot support one livestock unit weighing 250 kg for one year). The forages had low CP ranging from 40 to 55 g/kg DM. Most of herbage species such as *Cynodon* spp., *Cenchrus ciliaris, Eragrostis* spp. and *Panicum* spp. represent high nutritious herbages for ruminant animals that can be exploited.

**2. Characterization of livestock grazing management systems.** This study was conducted in the agro-silvopastoral systems of semi-arid areas of Kiteto and Kongwa districts. There is variability in grazing management systems in the two districts, due to variation in the land use system. At the on the onset of dry season, livestock are at first grazed on crop residues such as maize, sorghum and sunflower stovers and groundnut straws. Subsequently in Kongwa district farmers only rely on crop residues till the rains return. In Kiteto, onec the crop residues are exhausted, livestock are grazed on preserved pastures a Maasai agro-silvopastoral system locally called ‘Alalili’. Alalili. This Alalili agro-silvhopastoral technology and the associated crop residue-rangeland livestock grazing management represent one of the strong intensification and raised and feed resources in these semi-arid areas of Tanzania.

**3. Nutritive potential of tree foliage species and dry season livestock feed resources.** Browse tree foliages represent locally available cheap protein supplements to ruminants fed on low quality rangeland herbages and crop residues. Evaluations of nutritive potential of *Acacia senegal, A. torilis, A. xanthophloea, A. mellifera, Boscia mosambinscensis, Leucaena leucocephala,* and *Mellia azedrach common fodder* tree were done*. Leucaena leucocephala* and *Mellia azedrach* had the highest Crude protein contents (CP) of 231 and 249 gkg-1 dry matter (DM), respectively and *A. xanthophloea* had the lowest DM values (130 gkg-1 dry matter). Crude protein in other tree fodder ranged from 164-215 gkg-1 DM. As expected, CP in *Aristida* spp. (41 gkg-1) and maize stover (58 gkg-1) were below the minimum recommended values of 80 gkg-1 DM required for optimal rumen microbial functioning and animal productivity. *Boscia mosambiscensis* had the highest NDF, ADF and ADL contents of 665, 475, and 189 gkg-1 DM respectively. The corresponding values for other tested tree forage species were 354-570, 212-456 gkg-1. Overall tested browse tree foliage species had higher CP than the minimum dietary recommended level (80 gkg-1 DM) in ruminant diets, indicating that they can be used as protein supplements for the low qualify feeds resources such as *Aristida* spp. and maize stover, to enhance animal production.

**Section E. Success story** (In final report – 200-300 words)

**Title: New legume varieties expand horizons for food, nutrition and income security of dry land farmers in central Tanzania**

Farmers in Kiteto and Kongwa have every reason to be happy because finally they have had access to new improved groundnut and pigeonpea varieties, legumes well adapted to their dry-land agro-ecologies. Over the past year the ICRISAT led team has evaluated several new and released legumes (groundnuts and legumes) for adaptability in these areas that receive rains for a maximum of 50 days with (only 500 mm). Moreover, only 40% of these farmers have access to extension services leaving the vast majority with limited access to improved technologies. Through participatory variety selection implemented y this project, farmers have been able to identify varieties that increase yields by up to six fold, compared to their local varieties when produced under similar practices. Furthermore these new varieties are early maturing, guaranteeing early and good harvests for food, income and nutrition security. The highest yielding groundnut line ICGV-SM 02724 for example gave 1.5 t/ha compared to land race, which had 233 kg/ha, about three fold less in grain yield. All new pigeonpea varieties outstandingly yielded four -six times more than the local varieties with ICEAP 00557-giving 1779.2 t/ha compared to local variety that gave 125 Kg/ha. These new varieties could yield up to 2.5 tons.

**Section F**. **Feed the Future indicators** (In final report only)